PATENT ABSTRACTS OF JAPAN

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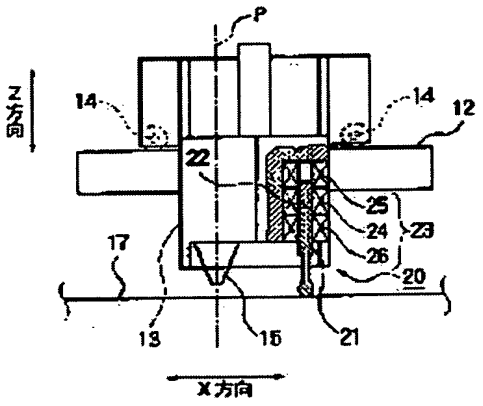
(54) SERIAL PRINTER

(57)Abstract:
PURPOSE: To provide a serial printer capable of performing printing stable in quality hardly affected by the surface shape of a printing medium by always keeping the interval between a printing head and the surface of the printing medium constant even when there is unevenness or inclination on the surface of the printing medium.
CONSTITUTION: A distance sensor 20 is provided in front of the main scanning direction in the vicinity of a printing head 15 and measures the distance up to the surface of a printing medium 17 during main scanning. The position in the Z-direction of the printing head 1 at a next dot forming position is regulated to control the distance between the leading end surface of the printing head 15 and the surface of the printing medium 17 to an ideal distance.



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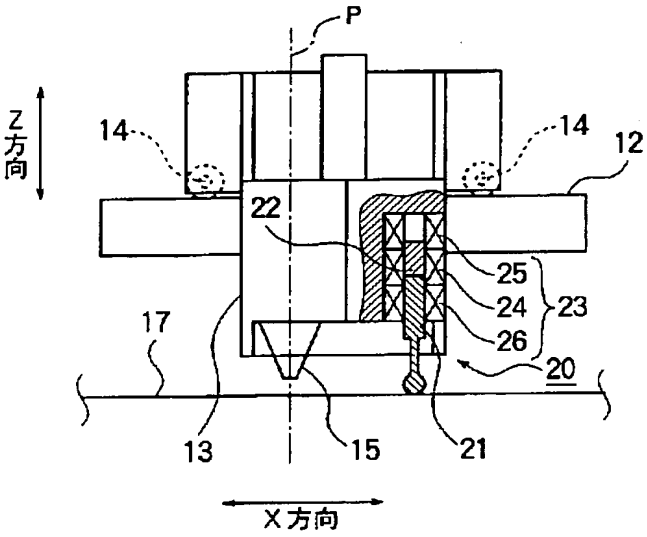
CLAIMS

[Claim(s)]
[Claim 1] In the serial printer which prints while scanning the front face of print media by the print head The print head migration means to which said print head is moved towards approaching and keeping away to said print media, In order to make in agreement with a predetermined ideal distance the distance between a range measurement means to output the signal which changes depending on the distance between said print heads and said print media, and under the scan of said print head, said print head and said print media The serial printer characterized by having the distance adjustment device which controls said print head migration means based on the output signal from said range measurement means.
[Claim 2] The serial printer characterized by having the distance robot to which said range measurement means moves with said print head, and measures the distance to said print media in scanning direction their predetermined location in a serial printer according to claim 1 rather than said print head.
[Claim 3] The serial printer with which said range measurement means is characterized by moving with said print head and having two distance robots prepared so that the distance to said print media in the predetermined location of scanning direction they and back might be measured rather than said print head in a serial printer according to claim 1.
[Claim 4] The serial printer characterized by to control said print head migration means according to said movement magnitude before it calculates the movement magnitude of said print head which needs said distance accommodation means in order to make the distance between said print head in the dot formation location of the future, and said print media in agreement with said ideal distance based on the output signal of said range measurement means in a serial printer according to claim 1 and said print head arrives at the dot formation location of said future.
[Claim 5] said distance adjustment device repeating migration of said print head by said print head migration means, and incorporation of the output signal from said range measurement means by turns during the scan of said print head, and performing incorporation of said output signal in a serial printer according to claim 1, after stable time amount predetermined [after the completion of migration of said print head] passes -- the serial printer characterized by things.
[Claim 6] The serial printer characterized by having further the means for stopping which stops the scan of said print head in a serial printer according to claim 1 to 5 when change of the output signal from said range measurement means is over the predetermined threshold.

[Translation done.]

Drawing selection | Representative drawing



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the serial printer suitable for printing an alphabetic character, an image, etc. to the print media which has a field with irregular field or inclination. The serial printer (henceforth an "ink jet printer") of an ink jet method is mentioned as an example, and this description explains it.
[0002]
[Description of the Prior Art] The printing element of an ink jet printer prints by forming the dot array of a fixed consistency on a printing record medium by gushing the ink of a constant rate from a canal orifice using the pressure from which a mechanical pressure is generally applied to ink by piezo-electric element 51 grade as shown in drawing 1 , or ink serves as air bubbles 53 with heating of a thermistor 52. Usually, when a printing element moves the print head arranged by the fixed consistency in the direction (lengthwise direction) of Y in the direction of X (longitudinal direction), one line is printed and only the distance which corresponds print media, subsequently to the arranged die length of a printing element, repeats actuation of sending in the direction of Y, printing for one-page print media is performed.
[0003]
[Problem(s) to be Solved by the Invention] Since each printing element flies the ink of a constant rate, if the distance between a print head and print media changes, variation will arise in each printing dot, and it will become impossible by the way, to perform printing by which the quality of printed character was stabilized. So, in order to keep the distance of a print head and print media constant, the device which fixes print media is prepared in the conventional ink jet printer. However, only print media with a thin and smooth field can keep the above-mentioned distance constant according to a fixed device, and it cannot keep the above-mentioned distance constant by the medium toward which the front face inclines since the medium and thickness which have irregularity in a front face change with locations.
[0004] Moreover, in order that a print head may raise printing precision, it is fixed to the Z direction which is a range direction with print media during horizontal scanning which is moving. Moreover, although there are some which established the adjustment device of the head location in a Z direction in order to enable printing of thick print media, accommodation of a head location is performed before initiation of printing, and the head location of a Z direction is too fixed during printing. Therefore, to print media with irregularity or dip, printing of high quality is difficult for a front face.
[0005] Therefore, even if the object of this invention has irregularity and dip on the surface of print media, it is to offer the serial printer which can perform printing by which the quality which is hard to be influenced in the shape of [of print media] surface type was stabilized, as the distance of a print head and print media can always be kept constant.

[0006]
[Means for Solving the Problem] In order to attain the above-mentioned object, the serial printer of this invention The print head migration means to which a print head is moved towards approaching and keeping away to print media, In order to make in agreement with a predetermined ideal distance the distance between a range measurement means to output the signal which changes depending on the distance between a print head and print media, and under the scan of a print head, a print head and print media It is characterized by having the distance adjustment device which controls a print head migration means based on the output signal from a range measurement means.
[0007]
[Function] According to the above-mentioned configuration, the signal according to the distance between a print head and print media is detected by the midst of a scan, and the distance location to the print media of a print head is adjusted based on this signal. Consequently, the location of a print head is adjusted according to the shape of surface type of print media, and the distance between a print head and print media is kept substantial in an ideal location.
[0008] In the suitable example, it moves with a print head and the distance robot which measures the distance to the print media in scanning direction their predetermined location rather than a print head is prepared as a range measurement means. If the signal from this distance robot is used, since the distance of the print head and print media in the attainment location of the future of a print head can predict easily, before a print head arrives at each dot formation location actually, based on this forecast, it becomes possible to control distance with print media in ideal distance. Moreover, a distance robot may be prepared not only in scanning direction them of a print head but in the method of method Kogo of a scan. Then, even if prediction count of the above-mentioned distance can carry out with a more sufficient precision or the scanning direction of printing changes, the above-mentioned control can be performed.
[0009] Moreover, in the suitable example, during the scan of a print head, a distance adjustment device repeats migration of the print head by the print head migration means, and incorporation of the output signal from a range measurement means by turns, and performs them. In that case, the signal incorporation from a range measurement means is performed, after stable time amount predetermined [after the completion of migration of a print head] passes. Thereby, an exact distance can be measured, without influencing the oscillation of the print head accompanying migration of a print head.
[0010] Furthermore, in this suitable example, when change of the output signal from a range measurement means is over the predetermined threshold, the scan of a print head is stopped. When the irregularity of the front face of print media is too large and it collides with a print head by this, a collision can be prevented and a print head can be protected.
[0011]
[Example] Hereafter, a drawing explains the example of this invention to a detail.
[0012] Drawing 3 shows the structure for a print head actuator of the serial printer concerning one example of this invention.
[0013] In drawing 3 , print media 17 is fixed to a fixed location to a base frame 11. Here, the longitudinal direction, lengthwise direction, and the thickness direction of print media 17 are called the direction of X, the direction of Y, and a Z direction, respectively, as an arrow head shows. In addition, since thickness differs in the direction of X, as for the print media 17 of a graphic display, the front face inclines to a X-Y flat surface.
[0014] It is attached in the base frame 11 in the condition in which both-way migration in the direction (the direction of vertical scanning) of Y is free by the motor which the guide rail 12 extended in the direction of X does not illustrate. The horizontal-scanning member 14 is attached in this guide rail 12 along with the guide rail 12 in the condition in which both-way migration in the direction of X

(main scanning direction) is free by the motor which is not illustrated. Furthermore, carriage 13 is attached in this horizontal-scanning member 14 through the Z direction migration device 16, and the print head 15 is attached in this carriage 13.

[0015] The Z direction migration device 16 is driven by the pulse motor which is for moving carriage 13 to a Z direction, for example, is not illustrated, in order to keep constant the distance of a print head 15 and the front face of print media 17. In addition, a linear motor and a linear actuator like a solenoid may be used for the Z direction migration device 16.

[0016] In such a configuration, printing to the front face of print media 17 is performed by performing horizontal scanning by moving carriage 13 along with a guide rail 12 by the horizontal-scanning member 14, and driving a print head 15 during horizontal scanning, vertical scanning being performed and repeating horizontal scanning and vertical scanning by moving a guide rail 12 in the direction of Y. The distance of a print head 15 and the front face of print media 17 is uniformly held by adjusting the Z direction location of carriage 13 according to the Z direction migration device 16 in the midst of this printing.

[0017] Drawing 4 and drawing 5 show the carriage 13 shown by drawing 3 , and the detail structure of the part of a print head 15, and the side elevation where drawing 5 R> 5 looked at this part for the side elevation where drawing 4 looked at this part along the direction of Y along the direction of X is shown, respectively.

[0018] Like a graphic display, in order to measure the distance between a print head 15 and the front face of the printing record medium 17 in the midst of horizontal scanning and vertical scanning, the distance robot 20 is formed near the print head 15.

[0019] As a partial cross section shows to drawing 4 , a distance robot 20 is the micrometer using a differential transformer attached in carriage 13, and consists of differential coils 23 in which a point generates the difference electrical potential difference according to the Z direction location of the front face of the printing record medium 17, contact 21 which can move to the Z direction which is always in a contact condition freely, the iron core 22 attached in the end face section of contact 21, and this iron core 22. the Z direction of the front face of the difference electrical potential difference which consisted of an exiting coil (primary coil) 24 and two secondary coils 25 and 26 which generate induced voltage, and was produced among secondary coils 25 and 26 to the print media 17 of a differential coil 23 is minute -- a variation rate may be recognized.

[0020] This distance robot 20 is arranged in the direction of Y in the same location as the printing element of the middle under printing element array (not shown) of the direction of Y of print head 15 apical surface, as are shown in drawing 4 , and only minute distance is estranged from a print head 15 in the direction of X and it is shown in drawing 5 .

[0021] Furthermore, this distance robot 20 is arranged so that it may always come ahead of the migration direction of a print head 15, in order to precede from a print head 15 during horizontal scanning and to perform range measurement. In drawing 4 , although the distance robot 20 is located in the right-hand side of a print head 15, this is a location in case horizontal scanning is performed in the direction of drawing Nakamigi.

[0022] Drawing 6 is the functional block diagram of the control device with which the printer of this example was equipped.

[0023] This control unit is equipped with CPU1, ROM2, RAM3, a host interface 4, the input interface 5, the direction of X motorised circuit 6, the direction [of Y] motorised circuit 7, the head actuation circuit 8, and the Z direction motorised circuit 9 like a graphic display.

[0024] A host interface 4 is an interface for receiving print data from external host equipment. The input interface 5 is an interface for inputting the signal from the various sensors in printers including the distance robot 20 shown in drawing 5 (not shown), and the signal from the control panel (not shown) of a printer.

[0025] CPU1 processes the print data from host equipment, through the direction of X and the direction [of Y] motorised circuits 6 and 7, or the head actuation circuit 8, printing actuation is controlled, or processes the signal from a distance robot 20, and performs data processing for adjusting the Z direction location of carriage 13 through the Z direction actuation circuit 9.
[0026] The printing processing program for controlling printing actuation which CPU1 described above, the font data of an alphabetic character, the position control program for performing Z direction centering control of the carriage 13 which CPU1 described above, etc. are stored in ROM2. The allowed value data of a concavo-convex change of printing record-medium 17 front face, the distance data of the direction of X between the printing element array of a print head 15 and a distance robot 20, etc. are built in the position control program. In addition, the above-mentioned allowed value data show the maximum of a concavo-convex change which can approve for not inviting breakage of a print head 15. Moreover, the above-mentioned spacing data are converted into the multiple of the dot pitch of printing, and show the direction distance of X between a printing element array and the location of a distance robot 20.
[0027] A receive buffer, a printing buffer, status area, a work area, etc. are set to RAM3.
[0028] By driving the direction motor of X which is not illustrated based on the control signal from CPU1, the direction of X motorised circuit 6 makes it run the horizontal-scanning member 14 shown in drawing 3 along with a guide rail 12, and performs horizontal scanning.
[0029] By driving Y directional movement motor which is not illustrated based on the control signal from CPU1, the direction [of Y] motorised circuit 7 moves the guide rail 12 shown in drawing 3 in the direction of Y, and performs vertical scanning.
[0030] When CPU1 processes print data, the head actuation circuit 8 drives the printing element of a print head 15 shown in drawing 3 in response to the bit map data developed on the printing buffer, and performs dot formation.
[0031] The Z direction motorised circuit 9 is for adjusting uniformly the distance between the apical surface of a print head 15, and printing record-medium 17 front face according to the Z direction migration device 16 shown in drawing 3 by driving the Z direction migration motor 16 which is not illustrated based on the control signal from CPU1.
[0032] Drawing 7 is the functional block diagram of the part for adjusting the Z direction location of a print head 15 in the configuration explained above.
[0033] The difference electrical potential difference outputted from the distance robot 20 is amplified with the amplifier 29 within an interface 5, and is digital-data-ized by A/D converter 30. This digital-data-ized difference electrical-potential-difference data is inputted into the head movement magnitude operation part 31 by CPU1, and the head movement magnitude operation part 31 calculates the movement magnitude of the Z direction of a print head 15. This movement magnitude is outputted to the Z direction migration motorised circuit 9. Thereby, since only the distance corresponding to movement magnitude moves [device / 16 / Z direction migration] carriage 13 to a Z direction, spacing of the apical surface of a print head 15 and print media 17 front face is always adjusted by constant value.
[0034] Hereafter, count of the above-mentioned movement magnitude of a print head 15 is explained to a detail.
[0035] If difference electrical-potential-difference data "0" are generated and the above-mentioned distance separates from ideal distance when the distance between the apical surface of a print head 15 and the front face of print media 17 is a predetermined ideal distance, the distance robot 20, the amplifier 29, and A/D converter 30 are beforehand adjusted and initialized so that the difference electrical-potential-difference data of the value corresponding to the difference may be generated. That is, difference electrical-potential-difference data express the difference distance from the ideal distance of the above-mentioned distance.

[0036] It is the direction distance of X between the printing element arrays and distance robots 20 the carrier beam head movement magnitude operation part 31 is first remembered to be by ROM2 in this difference electrical-potential-difference data, and the division of the above-mentioned difference electrical-potential-difference data is done. the value by which the above-mentioned direction distance of X was converted into the multiple of the dot pitch of printing here as mentioned above, for example, N dot pitch, -- it comes out. Therefore, although the above-mentioned division breaks the difference distance of measured N dot pitch point by N, it means that this had found the difference distance from the ideal distance between the head apical surfaces and printing record-medium 17 front faces in the next dot formation location (that is, only the current position of a print head to one dot pitch their location) of a current dot formation location by linear interpolation from the difference distance of measured N dot pitch point. In addition, in order for this linear interpolation to be effective, the dip of the front face of the print media 17 between N dot pitches needs to be substantially linear, but this condition will usually be satisfied except for an exception like [at the time of using a medium with surface intense irregularity], if N dot pitch is brief enough.
[0037] In this way, the value will be given to the Z direction motorised circuit 9 if the difference distance in the dot formation location of a degree is found. thereby -- the location of a print head 15 -- the above -- it is corrected by the difference distance in the dot formation location of a degree, and as a result, when a print head 15 comes to the dot formation location of a degree, the distance of a head apical surface and a printing intermediation body surface will be in agreement with ideal distance.
[0038] In addition, when the difference distance measured by the distance robot 20 exceeds the allowed value memorized by ROM the above process, since the irregularity of the front face of print media 17 is too large, it judges that a print head 15 and print media 17 may collide, and horizontal scanning is stopped promptly.
[0039] Next, the timing which performs the above control action is explained, referring to drawing 8 .
[0040] In the standby condition in front of horizontal-scanning initiation, initialization is performed so that the distance between a head side and a printing intermediation body surface may be in agreement with ideal distance. A print head 15 is moved in the direction of X, and horizontal scanning is started next. A distance robot 20 measures the distance between the head apical surfaces and printing intermediation body surfaces in the location where only fixed distance shifted ahead [main scanning direction] from the print head 15, as mentioned above.
[0041] Suppose that adjustment of the Z direction location of a print head 15 was now completed at time of day t1 in drawing 8 . Then, if the time of day t2 (the time amount of t1-t2 is hereafter called stable time amount) which the oscillation of the Z direction of the print head 15 which originated in this adjustment and was produced disappears thoroughly, and a print head 15 stops by the Z direction comes, printing actuation (timing a) by the head 15 and range measurement (timing b) in N dot pitch they location by the distance robot 20 will be performed in parallel. And if range measurement is continuously completed [printing actuation] and completed at time of day t4 in time of day t3 next, the operation of the movement magnitude mentioned above based on measurement distance will be performed (timing c).
[0042] If the operation of movement magnitude is completed at time of day t5, based on this movement magnitude, migration to the Z direction of a print head 15 will be performed (timing d). Although migration of this Z direction is completed at time of day t6, this finish time t6 is a stage by the stable time amount of a head earlier than the time of day t7 when a print head 15 arrives at the dot formation location of a degree.
[0043] The distance of a head apical surface and a printing intermediation body surface is always maintained at ideal distance during horizontal scanning by the above repeat.
[0044] Thus, if horizontal scanning of one line is completed and carriage 13 stops, contact 21 of a distance robot 20 will once be drawn in carriage 13. Then, a guide rail 12 moves to the location of the

following line, carriage 13 returns to a horizontal-scanning starting position, and again, contact 21 is extruded from carriage 13 and contacts a medium front face. Horizontal scanning of the following line is started in the previous line and this direction from this condition, and accommodation of a head location is performed during horizontal scanning like the above. The above actuation is repeated.

[0045] As explained above, according to this example, the character image which is hard to be influenced in the shape of [of print media 17] surface type and by which the quality of printed character was stabilized can be printed.

[0046] One example of this invention is not started to the last, this invention is not limited only to the above-mentioned content, and the content explained above can carry out other various modes.

[0047] For example, the distance robot which applied an optical device like a photo coupler as a distance robot can also be used. In this case, the distance between the head in the dot formation location of a degree and a medium front face can be measured directly, without performing interpolation count like the above-mentioned example for a distance robot by [of a print head] turning the direction of a beam of light to the dot formation location of a degree, even if it cannot attach in near extremely.

[0048] Moreover, when a distance sensor measures the difference distance in N dot pitch point from a print head like the above-mentioned example, you may make it use the measured difference distance for count of the head movement magnitude in the dot formation location of N dot pitch point, without performing the above interpolation count.

[0049] Moreover, head movement magnitude may be calculated by preparing a distance robot in a print head front and the back, and carrying out linear interpolation of the measurement distance of the two distance robots. Then, control more exact than the above-mentioned example is attained. In that case, if a distance robot is prepared in back a print head front, not only when horizontal scanning will be performed rightward [said], but when horizontal scanning is performed leftward, it becomes controllable [said single string]. Moreover, the same control is possible if it is the device in which a distance robot 20 rotates centering on the shaft P of drawing 4 , and it is located ahead of the scanning direction of a print head.

[0050] Furthermore, it is possible to raise the flattery nature of the print head to the dip in the above-mentioned example, even if it is sudden, if only the count which may be permitted from the stable time amount of a print head 15 mentioned above, spacing of printing timing, etc. makes the count of head positioning increase per one dot pitch although the count of accommodation of the head location per dot pitch is set up at once. [of the dip of the front face of print media]

[0051] Furthermore, since it not only makes a print head movable to a Z direction, but the apical surface of a head can be maintained at parallel to the medium front face which inclined along the main scanning direction as shown in drawing 3 if it constitutes from on a X-Z flat surface possible [a neck swing] centering on the shaft of the direction of Y, a higher quality of printed character is obtained.

[0052] Moreover, although a distance robot did not work, under vertical scanning uses a distance robot and you may make it, as for between vertical scanning, adjust the Z direction location of a print head in the above-mentioned example.

[0053] Moreover, although the head location was adjusted by digital data processing in the above-mentioned example, if it is adjusted so that the output of a distance robot 20 may become 0 or constant value to accuracy in ideal distance, highly precise accommodation of a head location is possible also by the analog-control system using a DC-servo-motor technique etc.

[0054] Moreover, although horizontal scanning and vertical scanning moved carriage in the above-mentioned example, this invention is applicable also to the common printer which is made to move print media and performs vertical scanning.

[0055]

[Effect of the Invention] Since according to this invention the distance of a print head and print media

is measured in parallel to printing and the location of a print head is adjusted as explained above, according to the field configuration of print media, the distance between a print head and print media can be substantially kept constant, and printing by which the quality which cannot be easily influenced by the field configuration of print media was stabilized can be performed.

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TECHNICAL FIELD

[Industrial Application] This invention relates to the serial printer suitable for printing an alphabetic character, an image, etc. to the print media which has a field with irregular field or inclination. The serial printer (henceforth an "ink jet printer") of an ink jet method is mentioned as an example, and this description explains it.

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PRIOR ART

[Description of the Prior Art] The printing element of an ink jet printer prints by forming the dot array of a fixed consistency on a printing record medium by gushing the ink of a constant rate from a canal orifice using the pressure from which a mechanical pressure is generally applied to ink by piezo-electric element 51 grade as shown in drawing 1 , or ink serves as air bubbles 53 with heating of a thermistor 52. Usually, when a printing element moves the print head arranged by the fixed consistency in the direction (lengthwise direction) of Y in the direction of X (longitudinal direction), one line is printed and only the distance which corresponds print media, subsequently to the arranged die length of a printing element, repeats actuation of sending in the direction of Y, printing for one-page print media is performed.

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EFFECT OF THE INVENTION

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Since each printing element flies the ink of a constant rate, if the distance between a print head and print media changes, variation will arise in each printing dot, and it will become impossible by the way, to perform printing by which the quality of printed character was stabilized. So, in order to keep the distance of a print head and print media constant, the device which fixes print media is prepared in the conventional ink jet printer. However, only print media with a thin and smooth field can keep the above-mentioned distance constant according to a fixed device, and it cannot keep the above-mentioned distance constant by the medium toward which the front face inclines since the medium and thickness which have irregularity in a front face change with locations.
[0004] Moreover, in order that a print head may raise printing precision, it is fixed to the Z direction which is a range direction with print media during horizontal scanning which is moving. Moreover, although there are some which established the adjustment device of the head location in a Z direction in order to enable printing of thick print media, accommodation of a head location is performed before initiation of printing, and the head location of a Z direction is too fixed during printing. Therefore, to print media with irregularity or dip, printing of high quality is difficult for a front face.
[0005] Therefore, even if the object of this invention has irregularity and dip on the surface of print media, it is to offer the serial printer which can perform printing by which the quality which is hard to be influenced in the shape of [of print media] surface type was stabilized, as the distance of a print head and print media can always be kept constant.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned object, the serial printer of this invention The print head migration means to which a print head is moved towards approaching and keeping away to print media, In order to make in agreement with a predetermined ideal distance the distance between a range measurement means to output the signal which changes depending on the distance between a print head and print media, and under the scan of a print head, a print head and print media It is characterized by having the distance adjustment device which controls a print head migration means based on the output signal from a range measurement means.

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OPERATION

[Function] According to the above-mentioned configuration, the signal according to the distance between a print head and print media is detected by the midst of a scan, and the distance location to the print media of a print head is adjusted based on this signal. Consequently, the location of a print head is adjusted according to the shape of surface type of print media, and the distance between a print head and print media is kept substantial in an ideal location.
[0008] In the suitable example, it moves with a print head and the distance robot which measures the distance to the print media in scanning direction their predetermined location rather than a print head is prepared as a range measurement means. If the signal from this distance robot is used, since the distance of the print head and print media in the attainment location of the future of a print head can predict easily, before a print head arrives at each dot formation location actually, based on this forecast, it becomes possible to control distance with print media in ideal distance. Moreover, a distance robot may be prepared not only in scanning direction them of a print head but in the method of method Kogo of a scan. Then, even if prediction count of the above-mentioned distance can carry out with a more sufficient precision or the scanning direction of printing changes, the above-mentioned control can be performed.
[0009] Moreover, in the suitable example, during the scan of a print head, a distance adjustment device repeats migration of the print head by the print head migration means, and incorporation of the output signal from a range measurement means by turns, and performs them. In that case, the signal incorporation from a range measurement means is performed, after stable time amount predetermined [after the completion of migration of a print head] passes. Thereby, an exact distance can be measured, without influencing the oscillation of the print head accompanying migration of a print head.
[0010] Furthermore, in this suitable example, when change of the output signal from a range measurement means is over the predetermined threshold, the scan of a print head is stopped. When the irregularity of the front face of print media is too large and it collides with a print head by this, a collision can be prevented and a print head can be protected.

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EXAMPLE

[Example] Hereafter, a drawing explains the example of this invention to a detail.
[0012] Drawing 3 shows the structure for a print head actuator of the serial printer concerning one example of this invention.
[0013] In drawing 3 , print media 17 is fixed to a fixed location to a base frame 11. Here, the longitudinal direction, lengthwise direction, and the thickness direction of print media 17 are called the direction of X, the direction of Y, and a Z direction, respectively, as an arrow head shows. In addition, since thickness differs in the direction of X, as for the print media 17 of a graphic display, the front face inclines to a X-Y flat surface.
[0014] It is attached in the base frame 11 in the condition in which both-way migration in the direction (the direction of vertical scanning) of Y is free by the motor which the guide rail 12 extended in the direction of X does not illustrate. The horizontal-scanning member 14 is attached in this guide rail 12 along with the guide rail 12 in the condition in which both-way migration in the direction of X (main scanning direction) is free by the motor which is not illustrated. Furthermore, carriage 13 is attached in this horizontal-scanning member 14 through the Z direction migration device 16, and the print head 15 is attached in this carriage 13.
[0015] The Z direction migration device 16 is driven by the pulse motor which is for moving carriage 13 to a Z direction, for example, is not illustrated, in order to keep constant the distance of a print head 15 and the front face of print media 17. In addition, a linear motor and a linear actuator like a solenoid may be used for the Z direction migration device 16.
[0016] In such a configuration, printing to the front face of print media 17 is performed by performing horizontal scanning by moving carriage 13 along with a guide rail 12 by the horizontal-scanning member 14, and driving a print head 15 during horizontal scanning, vertical scanning being performed and repeating horizontal scanning and vertical scanning by moving a guide rail 12 in the direction of Y. The distance of a print head 15 and the front face of print media 17 is uniformly held by adjusting the Z direction location of carriage 13 according to the Z direction migration device 16 in the midst of this printing.
[0017] Drawing 4 and drawing 5 show the carriage 13 shown by drawing 3 , and the detail structure of the part of a print head 15, and the side elevation where drawing 5 R> 5 looked at this part for the side elevation where drawing 4 looked at this part along the direction of Y along the direction of X is shown, respectively.
[0018] Like a graphic display, in order to measure the distance between a print head 15 and the front face of the printing record medium 17 in the midst of horizontal scanning and vertical scanning, the distance robot 20 is formed near the print head 15.
[0019] As a partial cross section shows to drawing 4 , a distance robot 20 is the micrometer using a differential transformer attached in carriage 13, and consists of differential coils 23 in which a point generates the difference electrical potential difference according to the Z direction location of the front

face of the printing record medium 17, contact 21 which can move to the Z direction which is always in a contact condition freely, the iron core 22 attached in the end face section of contact 21, and this iron core 22. the Z direction of the front face of the difference electrical potential difference which consisted of an exiting coil (primary coil) 24 and two secondary coils 25 and 26 which generate induced voltage, and was produced among secondary coils 25 and 26 to the print media 17 of a differential coil 23 is minute -- a variation rate may be recognized.

[0020] This distance robot 20 is arranged in the direction of Y in the same location as the printing element of the middle under printing element array (not shown) of the direction of Y of print head 15 apical surface, as are shown in drawing 4 , and only minute distance is estranged from a print head 15 in the direction of X and it is shown in drawing 5 .

[0021] Furthermore, this distance robot 20 is arranged so that it may always come ahead of the migration direction of a print head 15, in order to precede from a print head 15 during horizontal scanning and to perform range measurement. In drawing 4 , although the distance robot 20 is located in the right-hand side of a print head 15, this is a location in case horizontal scanning is performed in the direction of drawing Nakamigi.

[0022] Drawing 6 is the functional block diagram of the control device with which the printer of this example was equipped.

[0023] This control unit is equipped with CPU1, ROM2, RAM3, a host interface 4, the input interface 5, the direction of X motorised circuit 6, the direction [of Y] motorised circuit 7, the head actuation circuit 8, and the Z direction motorised circuit 9 like a graphic display.

[0024] A host interface 4 is an interface for receiving print data from external host equipment. The input interface 5 is an interface for inputting the signal from the various sensors in printers including the distance robot 20 shown in drawing 5 (not shown), and the signal from the control panel (not shown) of a printer.

[0025] CPU1 processes the print data from host equipment, through the direction of X and the direction [of Y] motorised circuits 6 and 7, or the head actuation circuit 8, printing actuation is controlled, or processes the signal from a distance robot 20, and performs data processing for adjusting the Z direction location of carriage 13 through the Z direction actuation circuit 9.

[0026] The printing processing program for controlling printing actuation which CPU1 described above, the font data of an alphabetic character, the position control program for performing Z direction centering control of the carriage 13 which CPU1 described above, etc. are stored in ROM2. The allowed value data of a concavo-convex change of printing record-medium 17 front face, the distance data of the direction of X between the printing element array of a print head 15 and a distance robot 20, etc. are built in the position control program. In addition, the above-mentioned allowed value data show the maximum of a concavo-convex change which can approve for not inviting breakage of a print head 15. Moreover, the above-mentioned spacing data are converted into the multiple of the dot pitch of printing, and show the direction distance of X between a printing element array and the location of a distance robot 20.

[0027] A receive buffer, a printing buffer, status area, a work area, etc. are set to RAM3.

[0028] By driving the direction motor of X which is not illustrated based on the control signal from CPU1, the direction of X motorised circuit 6 makes it run the horizontal-scanning member 14 shown in drawing 3 along with a guide rail 12, and performs horizontal scanning.

[0029] By driving Y directional movement motor which is not illustrated based on the control signal from CPU1, the direction [of Y] motorised circuit 7 moves the guide rail 12 shown in drawing 3 in the direction of Y, and performs vertical scanning.

[0030] When CPU1 processes print data, the head actuation circuit 8 drives the printing element of a print head 15 shown in drawing 3 in response to the bit map data developed on the printing buffer, and performs dot formation.

[0031] The Z direction motorised circuit 9 is for adjusting uniformly the distance between the apical surface of a print head 15, and printing record-medium 17 front face according to the Z direction migration device 16 shown in drawing 3 by driving the Z direction migration motor 16 which is not illustrated based on the control signal from CPU1.
[0032] Drawing 7 is the functional block diagram of the part for adjusting the Z direction location of a print head 15 in the configuration explained above.
[0033] The difference electrical potential difference outputted from the distance robot 20 is amplified with the amplifier 29 within an interface 5, and is digital-data-ized by A/D converter 30. This digital-data-ized difference electrical-potential-difference data is inputted into the head movement magnitude operation part 31 by CPU1, and the head movement magnitude operation part 31 calculates the movement magnitude of the Z direction of a print head 15. This movement magnitude is outputted to the Z direction migration motorised circuit 9. Thereby, since only the distance corresponding to movement magnitude moves [device / 16 / Z direction migration] carriage 13 to a Z direction, spacing of the apical surface of a print head 15 and print media 17 front face is always adjusted by constant value.
[0034] Hereafter, count of the above-mentioned movement magnitude of a print head 15 is explained to a detail.
[0035] If difference electrical-potential-difference data "0" are generated and the above-mentioned distance separates from ideal distance when the distance between the apical surface of a print head 15 and the front face of print media 17 is a predetermined ideal distance, the distance robot 20, the amplifier 29, and A/D converter 30 are beforehand adjusted and initialized so that the difference electrical-potential-difference data of the value corresponding to the difference may be generated. That is, difference electrical-potential-difference data express the difference distance from the ideal distance of the above-mentioned distance.
[0036] It is the direction distance of X between the printing element arrays and distance robots 20 the carrier beam head movement magnitude operation part 31 is first remembered to be by ROM2 in this difference electrical-potential-difference data, and the division of the above-mentioned difference electrical-potential-difference data is done. the value by which the above-mentioned direction distance of X was converted into the multiple of the dot pitch of printing here as mentioned above, for example, N dot pitch, -- it comes out. Therefore, although the above-mentioned division breaks the difference distance of measured N dot pitch point by N, it means that this had found the difference distance from the ideal distance between the head apical surfaces and printing record-medium 17 front faces in the next dot formation location (that is, only the current position of a print head to one dot pitch their location) of a current dot formation location by linear interpolation from the difference distance of measured N dot pitch point. In addition, in order for this linear interpolation to be effective, the dip of the front face of the print media 17 between N dot pitches needs to be substantially linear, but this condition will usually be satisfied except for an exception like [at the time of using a medium with surface intense irregularity], if N dot pitch is brief enough.
[0037] In this way, the value will be given to the Z direction motorised circuit 9 if the difference distance in the dot formation location of a degree is found. thereby -- the location of a print head 15 -- the above -- it is corrected by the difference distance in the dot formation location of a degree, and as a result, when a print head 15 comes to the dot formation location of a degree, the distance of a head apical surface and a printing intermediation body surface will be in agreement with ideal distance.
[0038] In addition, when the difference distance measured by the distance robot 20 exceeds the allowed value memorized by ROM the above process, since the irregularity of the front face of print media 17 is too large, it judges that a print head 15 and print media 17 may collide, and horizontal scanning is stopped promptly.
[0039] Next, the timing which performs the above control action is explained, referring to drawing 8 .

[0040] In the standby condition in front of horizontal-scanning initiation, initialization is performed so that the distance between a head side and a printing intermediation body surface may be in agreement with ideal distance. A print head 15 is moved in the direction of X, and horizontal scanning is started next. A distance robot 20 measures the distance between the head apical surfaces and printing intermediation body surfaces in the location where only fixed distance shifted ahead [main scanning direction] from the print head 15, as mentioned above.
[0041] Suppose that adjustment of the Z direction location of a print head 15 was now completed at time of day t1 in drawing 8 . Then, if the time of day t2 (the time amount of t1-t2 is hereafter called stable time amount) which the oscillation of the Z direction of the print head 15 which originated in this adjustment and was produced disappears thoroughly, and a print head 15 stops by the Z direction comes, printing actuation (timing a) by the head 15 and range measurement (timing b) in N dot pitch they location by the distance robot 20 will be performed in parallel. And if range measurement is continuously completed [printing actuation] and completed at time of day t4 in time of day t3 next, the operation of the movement magnitude mentioned above based on measurement distance will be performed (timing c).
[0042] If the operation of movement magnitude is completed at time of day t5, based on this movement magnitude, migration to the Z direction of a print head 15 will be performed (timing d). Although migration of this Z direction is completed at time of day t6, this finish time t6 is a stage by the stable time amount of a head earlier than the time of day t7 when a print head 15 arrives at the dot formation location of a degree.
[0043] The distance of a head apical surface and a printing intermediation body surface is always maintained at ideal distance during horizontal scanning by the above repeat.
[0044] Thus, if horizontal scanning of one line is completed and carriage 13 stops, contact 21 of a distance robot 20 will once be drawn in carriage 13. Then, a guide rail 12 moves to the location of the following line, carriage 13 returns to a horizontal-scanning starting position, and again, contact 21 is extruded from carriage 13 and contacts a medium front face. Horizontal scanning of the following line is started in the previous line and this direction from this condition, and accommodation of a head location is performed during horizontal scanning like the above. The above actuation is repeated.
[0045] As explained above, according to this example, the character image which is hard to be influenced in the shape of [of print media 17] surface type and by which the quality of printed character was stabilized can be printed.
[0046] One example of this invention is not started to the last, this invention is not limited only to the above-mentioned content, and the content explained above can carry out other various modes.
[0047] For example, the distance robot which applied an optical device like a photo coupler as a distance robot can also be used. In this case, the distance between the head in the dot formation location of a degree and a medium front face can be measured directly, without performing interpolation count like the above-mentioned example for a distance robot by [of a print head] turning the direction of a beam of light to the dot formation location of a degree, even if it cannot attach in near extremely.
[0048] Moreover, when a distance sensor measures the difference distance in N dot pitch point from a print head like the above-mentioned example, you may make it use the measured difference distance for count of the head movement magnitude in the dot formation location of N dot pitch point, without performing the above interpolation count.
[0049] Moreover, head movement magnitude may be calculated by preparing a distance robot in a print head front and the back, and carrying out linear interpolation of the measurement distance of the two distance robots. Then, control more exact than the above-mentioned example is attained. In that case, if a distance robot is prepared in back a print head front, not only when horizontal scanning will be performed rightward [said], but when horizontal scanning is performed leftward, it becomes

controllable [said single string]. Moreover, the same control is possible if it is the device in which a distance robot 20 rotates centering on the shaft P of drawing 4 , and it is located ahead of the scanning direction of a print head.

[0050] Furthermore, it is possible to raise the flattery nature of the print head to the dip in the above-mentioned example, even if it is sudden, if only the count which may be permitted from the stable time amount of a print head 15 mentioned above, spacing of printing timing, etc. makes the count of head positioning increase per one dot pitch although the count of accommodation of the head location per dot pitch is set up at once. [of the dip of the front face of print media]

[0051] Furthermore, since it not only makes a print head movable to a Z direction, but the apical surface of a head can be maintained at parallel to the medium front face which inclined along the main scanning direction as shown in drawing 3 if it constitutes from on a X-Z flat surface possible [a neck swing] centering on the shaft of the direction of Y, a higher quality of printed character is obtained.

[0052] Moreover, although a distance robot did not work, under vertical scanning uses a distance robot and you may make it, as for between vertical scanning, adjust the Z direction location of a print head in the above-mentioned example.

[0053] Moreover, although the head location was adjusted by digital data processing in the above-mentioned example, if it is adjusted so that the output of a distance robot 20 may become 0 or constant value to accuracy in ideal distance, highly precise accommodation of a head location is possible also by the analog-control system using a DC-servo-motor technique etc.

[0054] Moreover, although horizontal scanning and vertical scanning moved carriage in the above-mentioned example, this invention is applicable also to the common printer which is made to move print media and performs vertical scanning.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The outline sectional view showing the principle of the printing element of an ink jet printer.
[Drawing 2] The outline sectional view showing the principle of another printing element of an ink jet printer.
[Drawing 3] The perspective view showing the structure of the head drive part of the ink jet printer concerning one example of this invention.
[Drawing 4] The side elevation showing the structure which looked at the carriage of this example, and the part of a head along the direction of vertical scanning.
[Drawing 5] The side elevation showing the structure which looked at the carriage of this example, and the part of a head along the main scanning direction.
[Drawing 6] The block diagram showing the hardware configuration of the control device of this example.
[Drawing 7] The block diagram showing the function of the part for moving the print head of the control devices of drawing 6 to a Z direction.
[Drawing 8] The timing chart which shows the time relation of the control and printing which move the print head in this example to a Z direction.
[Description of Notations]
1 CPU
2 ROM
3 RAM
4 Host Interface
5 Input Interface
6 The Direction of X Motorised Circuit
7 The Direction [of Y] Motorised Circuit
8 Head Actuation Circuit
9 Z Direction Motorised Circuit
12 Guide Rail
13 Carriage
14 Horizontal-Scanning Member
15 Print Head
16 Z Direction Migration Device
17 Print Media
20 Distance Robot
29 Amplifier
30 A/D Converter

31 Head Movement Magnitude Operation Part

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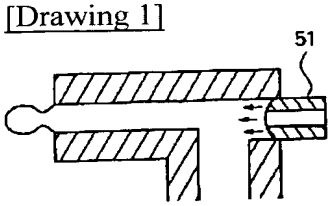
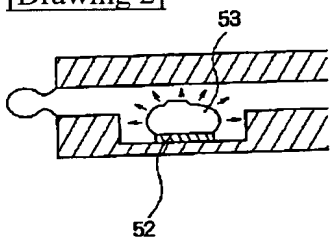
DRAWINGS

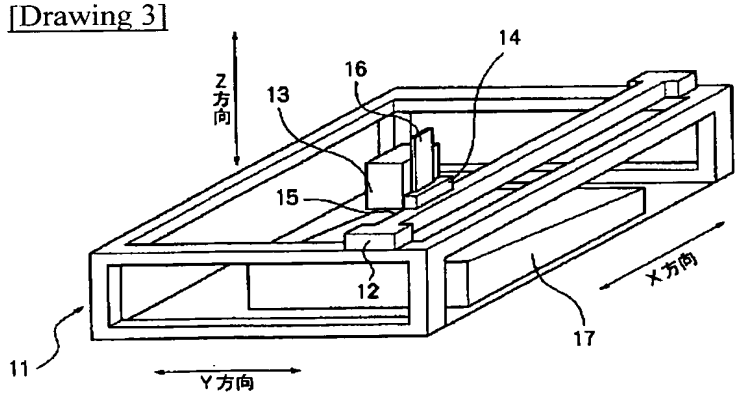
[Drawing 1]



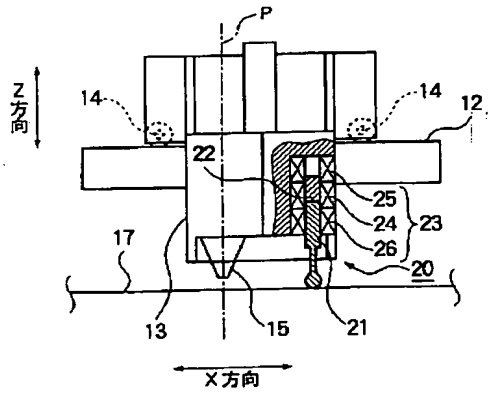
[Drawing 2]



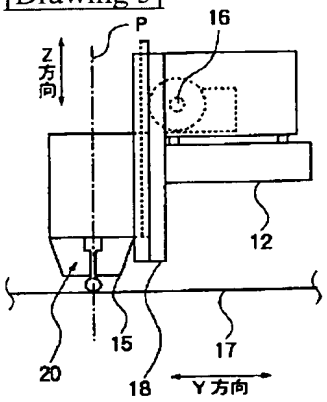
[Drawing 3]



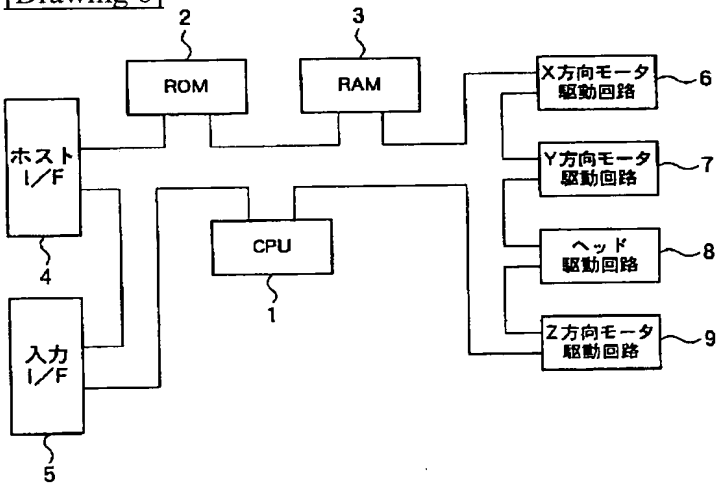
[Drawing 4]



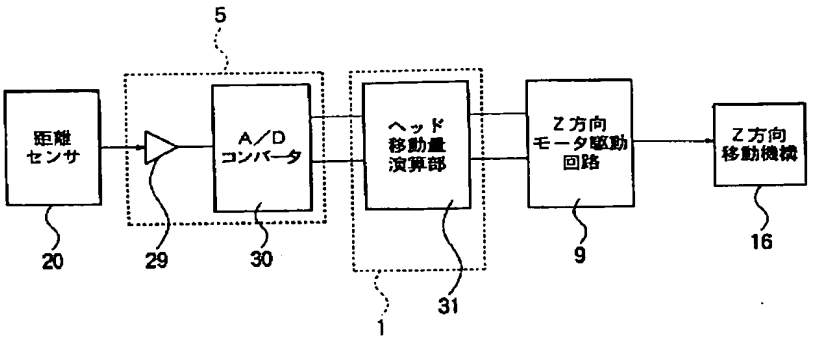
[Drawing 5]



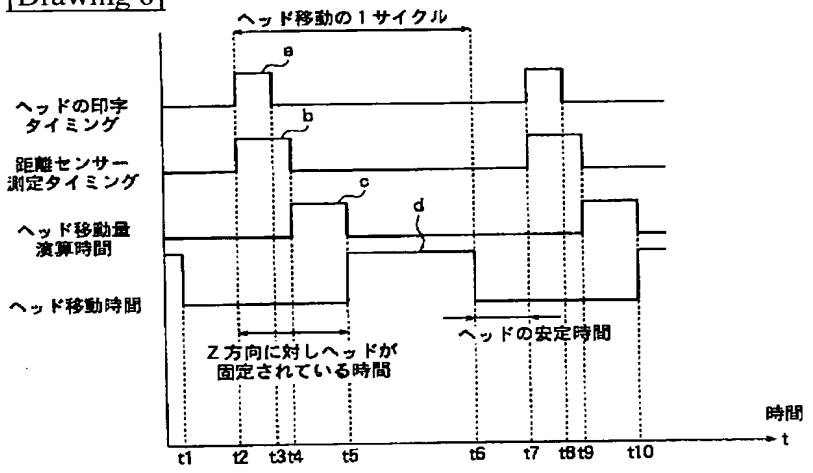
[Drawing 6]



[Drawing 7]



[Drawing 8]



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